the Service to new area investigation necessarily reflected the amount and detail of regional biogeographic surveys. Indeed the period up to 1975 saw rapid development of regional and detailed surveys as well as attempts at systemitizing the conservation status of plant and animal communities and species native to Australia.

John Whitehouse's paper acknowledges most of the events in the growth of knowledge of conservation needs in New South Wales but fails to acknowledge the contributions of the Fauna Protection Panel and staff of the National Parks and Wildlife Service at the time.

The article reflects the point of view of the writer looking back from 1989 to the 60s and 70s but missing the ambience of those earlier times.

The model

My comments on John Whitehouse's "model" for nature conservation are offered in the context that I believe that this "initiative" reflects a limited view of past nature conservation programmes. I am sure that others more recently involved in land investigation will be critical of the underlying science of the model, and my comments will be much more limited.

The model proposed, as I understand it, intends to do two things:

- to redirect programming from an "area based" consideration to one of being "reserve based"; and thus
- to provide a mechanism for "explicitly and logically formulating a nature conservation programme" which will maximize land acquired for money (and other resources?) spent.

Two sets of distinctions are made in the model which are curious in so far as they are used to define the model and are seen as mutually exclusive:

- a difference is made between a "land based" nature conservation programme and a "resourced based" nature conservation programme; and
- a distinction is made between sampling based on genetic diversity and one on species diversity as the basis of such a resource based nature conservation programme.

There is an implication that in the past investigation in the article was "land based" (whatever that really means) and not "resource based". Surely the establishment and management of a nature conservation system is land based (since land is reserved or declared), but land is selected for such reservation/declaration on the basis of its utility or ability to satisfy needs — in this case its value for nature conservation purposes.

I suspect that other responses will argue that considerations of both genetic diversity and species diversity are important in establishing the relative merits of including an area in the nature conservation system. Other considerations will also be taken into account including scenery, cuddly animals etc. depending on the pragmatics of the situation at the time (i.e., politics, funding, opportunism).

This may be "irrational" in a scientific sense, but while nature conservation is as much a political process as anything else, debate about the nuances of species diversity versus genetic diversity will not be very relevant. There is nothing in the article that proposes alternative political and bureaucratic structures more suited to a perfect, rational world based on ensuring that Gaia not only continues to maintain genetic and species diversity but also heals herself for the benefit of us all.

Scientific knowledge: The basis for establishing reserves

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This contains some of my personal views on reserve selection and wildlife conservation based on 11 years working in this field with the National Parks and Wildlife Service of New South Wales.

The origin of public nature conservation reserves

The driving forces behind early reservation of lands for nature conservation were heavily tinged with romanticism. In the United States, the modern concept of nature conservation began with Thoreau; was given impetus by the accounts of natural marvels such as Yosemite Valley by surveyors such as Clarence King in 1864 and in the writings of John Muir; then depicted by artists such as Albert Bierstadt and photographers such as William Henry Jackson and Carlton Watkins. The idea of a National Park came from Nathanial Langford while exploring the Yellowstone River. Americans were so aroused by these writings, art and photography that Congress established the world's first National Park at Yellowstone in 1872.

If we analyze the growth in the public awareness towards nature conservation in Australia we see similar patterns, albeit later than the American transition — in the 1920s and 30s, Myles J. Dunphy writings and surveys on the Great Dividing Range and in the 1960s and 1970s Olegas Truchanus' photography of Lake Pedder.

Unfortunately, by the time more scientific approaches to conservation came about in Australia, based on criteria such as representativeness, options for reserves had been severely reduced by the massive alteration to the countryside by European exploitation, particularly in flatter terrain with higher nutrient soils (Benson 1989).

The Nature Conservation Review of New South Wales (1983-1985)

One source of information relied on in Whitehouse (1990) for information and concepts is an unpublished document by Hitchcock (1985). This summarized the interim findings of what had been a two year programme by the National Parks and Wildlife Service of New South Wales of assessing the achievements and deficiencies of nature conservation in New South Wales. The Review was initiated after it was realized the organization needed to take stock of its achievements, which had been considerable during the previous decade, and set more objective priorities for the next decade. Its intention was to lay the basis for resource-based reservation in the coming times of both increased threats to the remnants of nature in New South Wales and diminishing public funds to secure them. The Review set out to cover the full ambit of nature conservation ranging from abiotic themes such as karst, geological sites of significance and wilderness to the biotic environment including rare species, plant communities, specific groups of animals such as bandicoots, bats and invertebrates. Although 40 of the 60 papers called for to underpin this Review were drafted, none was ever published. Hitchcock (1985) outlined several options for further progress and implementation of the Review. The Review was never completed.

Other states carried out similar conservation reviews but published them (Government of Victoria 1987; Conservation and Environment Council of Western Australia 1983). A hiatus continues in New South Wales and we still do not have thorough documentation on the adequacy of the present reserve system, particularly for fauna.

In a discussion on the basis for reserve selection in New South Wales, Whitehouse (1990) concludes that reserve selection is best undertaken using a resource-based approach rather than a land-based approach. This view is not unusual and most modern reserve design theories adhere to them. To achieve this, however, a necessary prerequisite is the collection and collation of a certain level of information about the natural features that occur in the region under scrutiny. This synthesis would normally rely upon systematic survey data, land-form data, specific research results and sundry records such as those held by herbaria, museums and scientific experts. Of equal importance is the gaining of an objective appreciation of the present conservation status of species, habitats or other natural features in a region.

A critical point is that the reserve selection process, achieved by whatever means, is likely to produce better results if a stocktaking is made of the present status of whatever factors are to be used in a reserve selection programme. For example, Pressey's (this issue) reserve selection algorithmns can produce better results if they can incorporate data on existing reserves or the status of species.

The need for information systems

Whitehouse (1990) did not mention the advantage of assimilating data on the distribution and abundance of species or communities so that more effective resource-based conservation decisions can be made. Over the years a number of information systems have been proposed and several are now being developed. For example, a rare or threatened Australian plant database is currently being developed as is a database containing areas of conservation interest. These information systems will greatly aid reserve selection, particularly when they can be integrated into a partial or full geographical information system. Also, they set a base for producing hypotheses that can be pursued by more detailed research.

Plant communities as the basis of reserve selection

Whitehouse (1990) lists a number of plant communities considered to be poorly conserved or threatened. The source of this material was a preliminary analysis of the situation by myself in 1984 which was included as an appendix in Hitchcock (1985). A more thorough analysis of the conservation status of plant associations was prepared and made available within the Department in 1987 and was published in Benson (1989).

Work has commenced on the New South Wales section of the revision of the report by Specht *et al.* (1974). As Whitehouse (1990) notes, Specht *et al.*'s plant communities were often at a level too coarse to distinguish significant variation on a regional scale. In a recent address, Peter Raven, Director of the Missouri Botanic Gardens, advocated that if habitat classification were to be used for selecting reserves, it should be at a fine enough level to encompass the vast majority of species.

While providing an Australia-wide overview, it is doubtful that Specht's current Floristic Groups produced by a TWINSPAN analysis of about 2 000 vegetation surveys covering the continent are at a fine enough level of classification for the individual states to use to develop detailed reserve strategies.

To overcome this deficiency, one proposal is to break down the vegetation of New South Wales to the level of a plant association. Where possible this should take into account strata other than the canopy. This classification is already being used by some conservation agencies in Australia for reserve selection or setting priorities in other programmes. It is unfortunate that more resources have not been allocated to complete this classification in New South Wales, because the data are increasingly being sought. The Federal Government's Resource Assessment Commission, currently investigating Australia's forests and the forestry industries, has recently requested details on the conservation of plant associations from all Australian government conservation agencies.

Whitehouse (1990) concludes with a recommendation that plant communities be used as the foundation of a sampling strategy which aims to conserve ecological diversity. Botanists may approve of such an approach. It may be supported because of the availability of considerable data on the distribution and abundance of plant species and the fact that vegetation can be relatively easily mapped at resolutions useful for making land-use decisions. Also, it has always been assumed that a majority of fauna will be protected in reserves which have been selected from methodologies based on adequately sampling plant communities (Specht, this issue). Zoologists may disagree with this basis for selecting reserves. Of popular concern are slow breeding, wide-ranging and migratory animals. In China adequate populations of the Giant Panda will not be conserved by only reserving a few stands of bamboo. It is a more complex task. Who knows what the long-term requirements are for Spotted-tailed Quoll, potoroos and the Red Goshawk.

Off-park conservation

It is important to realize that lands set aside for conservation reserves are unlikely to adequately conserve all species, habitats or natural phenomena. The responsibilities inscribed in the legislation governing most Australian conservation agencies empowers them to go beyond park boundaries in conserving natural and cultural resources.

A flaw in the comparisons of the United States and New South Wales conservation agencies made in Whitehouse (1990) is that he does not mention that there was later established a supplementary organization in the USA, the Fish and Wildlife Service. This organization plays crucial roles in scientific research and off-park conservation such as administering the US *Endangered Species Act*. There is also the Wilderness Act (1964) which binds several different US land management agencies. Wilderness areas are declared across national forests, lands managed by the Bureau of Land Management and national parks administered by the National Parks Service.

To a large degree the legislation governing the workings of the National Parks and Wildlife Services in New South Wales, Tasmania, South Australia and Queensland are analogous to an amalgam of the US legislation. It is therefore not sufficient to compare the NPWS of New South Wales to only the US Parks Service.

While the legislation governing off-park wildlife and habitat conservation in New South Wales needs improvement, there are key laws involving several government agencies which can effect non-reserve environmental conservation. Some of these laws are not being adequately implemented.

The future

While Whitehouse (1990) mentions that the NPWS of New South Wales can "boast the responsibility of management of . . . 4.62% of the land surface of New South Wales", it should be noted that Tasmania, Victoria, Western Australia, the Australian Captial Territory and South Australia have a higher percentage of their respective land areas reserved for nature conservation. While percentage area does not necessarily imply adequate representativeness, condition, viability or management there is little doubt that New South Wales has some way to go in reserve establishment. The diminishing Crown lands will still play an important part in this process but over the longer term funding for land acquisition will need to be more carefully addressed towards priority areas based on representativeness, rare species, real rather than perceived management problems and outstanding physical or cultural features.

The six key limiting factors in conservation at present are: the fact that political factors are likely to continue to play a major role in decision making — sometimes this will be beneficial but often conservation priorities will be overridden; a lack of data on which to base a rationale for the selection of new reserves; a lack of taxonomic descriptions for some groups of organisms e.g., fungi and invertebrates; a lack of knowledge about the long-term requirements of most species, even key species in ecosystems; a lack of scientific emphasis in managing most reserves; and a lack of funds to acquire important areas.

Even if we devise a proposed representative reserve system after having employed the best analytical techniques, unless funds are available to acquire and manage the lands it would only have served as an academic exercise. Clearly there needs to be improved funding of these key programmes. There is also a requirement for better off-park conservation via incentive schemes (tax concessions and the like) to protect significant sites. In New South Wales it is essential that the Conservation Agreement legislation of 1987 and any future endangered species legislation should be staffed and funded.

To overcome the present deficiencies in the reserve system and in off-park conservation of wildlife generally, an integrated approach on land-use is necessary. This ought to have as its basis sound scientific information and this can only come about by re-arranging priorities of government and non-government conservation and natural resource based organizations.

If the NPWS of New South Wales is to be concerned with a sound basis to reserve selection and management a greater proportion of funds should be directed towards survey, information systems, applied research, land acquisition and scientifically based land-management.

Reserve selection in New South Wales should pay more attention to the presence of species and habitats which are poorly represented in reserves and/or are threatened. Once they are lost they cannot be replaced. Complementary conservation measures involving a range of legislation, authorities and individual landholders are required if extinctions of wildlife are to be prevented.

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Response to Conserving What? — The basis for nature conservation reserves in New South Wales 1967-1989

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The paper by John Whitehouse is an important contribution to the analysis of Australia's national parks and nature reserves system. I hope it will stimulate debate, analysis and review, which will lead ultimately to a different and improved nature conservation system in Australia. Australia's parks and reserves are inadequate by themselves to ensure the long-term conservation of the continent's biota and there is an urgent need to extend the conservation and management of Australia's plant and animal communities to all land regardless of tenure. The nation's system of reserves is not representative of the continent's biotic diversity and has developed largely in response to political pressures without much consideration of long-term conservation objectives, sampling strategies or the requirements of flora and fauna. There has been little scientific direction of the reserve system and no systematic review of progress which might lead to the re-direction of efforts or the identification of deficiencies and needs. These were precisely the points Whitehouse made in his paper.

The design of a reserve system for nature conservation has two components; (1) a sampling strategy with clear objectives, and (2) the size, shape, number and distribution of reserves. Whitehouse plays down the importance of the latter, but validly points out that the reserve system in New South Wales has generally not adhered to scientific principles in satisfying either of the two design components. The system of reserves in New South Wales has developed in response to public pressure (both for and against reservation of particular areas), to attitudes within the Service itself which emphasized forests, wild areas and the absence of human disturbance, to the availability of land at least economic and